that structure is well practicable. The data of Table 5-(b) are for the case of y = 0.8 nanometers (Hpin is increased in some degree). In the structure of this case, the bias point data are better than those in the structure of (a) in which the bias point data are shifted lower. The case of (c) in which Hin is lowered also gives good bias point data. Comparing the data of (a), (b) and (c) in Table 5, it is obvious that Hin is preferably as small as possible. This is because of the reduced MR height dependence of the bias point. In the Synthetic AF structure, the smaller thickness difference between the upper and lower pinned layers gives smaller Hpin, thereby resulting in smaller MR height dependence of the bias point. However, the difference of 0.3 nanometers between (a) and (b) could be negligible. Preferably, therefore, y = 0 to 1 nanometer (Ms×t = 0 to 1.8 nanometer Tesla in NiFe), more preferably, y = 0 to 0.5 nanometers (Ms×t = 0 to 0.9 nanometer Tesla in NiFe). Within the preferred range, the value y is easy to control for obtaining good bias points and for improving other characteristics of the film including ESD resistance, etc.

The subbing Cu layer is for bias point control and for MR spin filter effect. Increasing the subbing Cu thickness results in small Hcu, but also results in ΔRs reduction. Preferably, therefore, the Cu thickness falls between 0.5 nanometers and 4 nanometers, more preferably between 0.5

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nanometers and 3 nanometers. The subbing Cu thickness enough for the MR spin filter effect depends on the constitution of the free layer. With the free layer being thin, the most preferred thickness of the subbing Cu layer enough for the MR spin filter effect will shift to a larger value. In experiments, the peak of MR ratio appeared when the total thickness of the subbing Cu layer and the free layer fell between 4 nanometers and 5 nanometers.

In the free layer constitution in (7-1) where the subbing Cu thickness is from 0 to 1.5 nanometers, the MR increase owing to the spin filter effect of the increased Cu thickness will cancel the Rs reduction to be caused by the increase in the Cu thickness, and ΔRs changes little. In another where the subbing Cu thickness is from 1.5 nanometers to 2 nanometers, however, ΔRs will decrease by about 0.1 Ω; and in still another where the subbing Cu thickness is from 1.5 nanometers to 3 nanometers, ΔRs will decrease by about 0.25 Ω. The ΔRs reduction shall be nearly proportional to the output reduction, and is therefore unfavorable. However, if thick subbing Cu is desired for bias point control, the subbing Cu thickness could be 3 nanometers in the free layer constitution illustrated. In this case, since the current magnetic field per the unit current is small and since the spin valve film resistance is lowered, the output reduction to be caused by the ΔRs reduction could be retarded by applying

increased current. This is because the output is also proportional to the applied current. If ΔRs has decreased by 10 % owing to the increase in the subbing Cu thickness, the calculated sense current of 4 mA may be increased to 5 mA whereby the output will increase by 25 %. In that manner, the output reduction caused by the ΔRs reduction could be well compensated for by the current increase.

For a thick free layer of 4 nm NiFe/0.5 nm CoFe, the subbing Cu thickness is preferably from 0.5 to 2 nanometers or so; but for a thin free layer of 1 nm NiFe/0.5 nm CoFe, the subbing Cu thickness is preferably from 1 to 4 nanometers or so. The thickness of the interlayer of CoFe may be varied within a range of from 0.3 to 1.5 nanometers. In place of CoFe, also employable is any of Co or other Co alloys. Where Co is used in place of CoFe, its thickness is preferably as small as possible. This is because the Co single substance could not be soft magnetic by itself.

For example, when NiFe is 4 nanometers thick, then Co is preferably from 0 to 1 nanometer thick; when NiFe is 2 nanometers thick, then Co is preferably from 0 to 0.5 nanometers thick; and when NiFe is 1 nanometer thick, then Co is preferably from 0 to 0.3 nanometers thick. If the interfacial diffusion from the subbing Cu is desired to be prevented, a layer of a material not forming a solid solution with Cu, for example, Co or CoFe could be put between the subbing Cu layer and the